

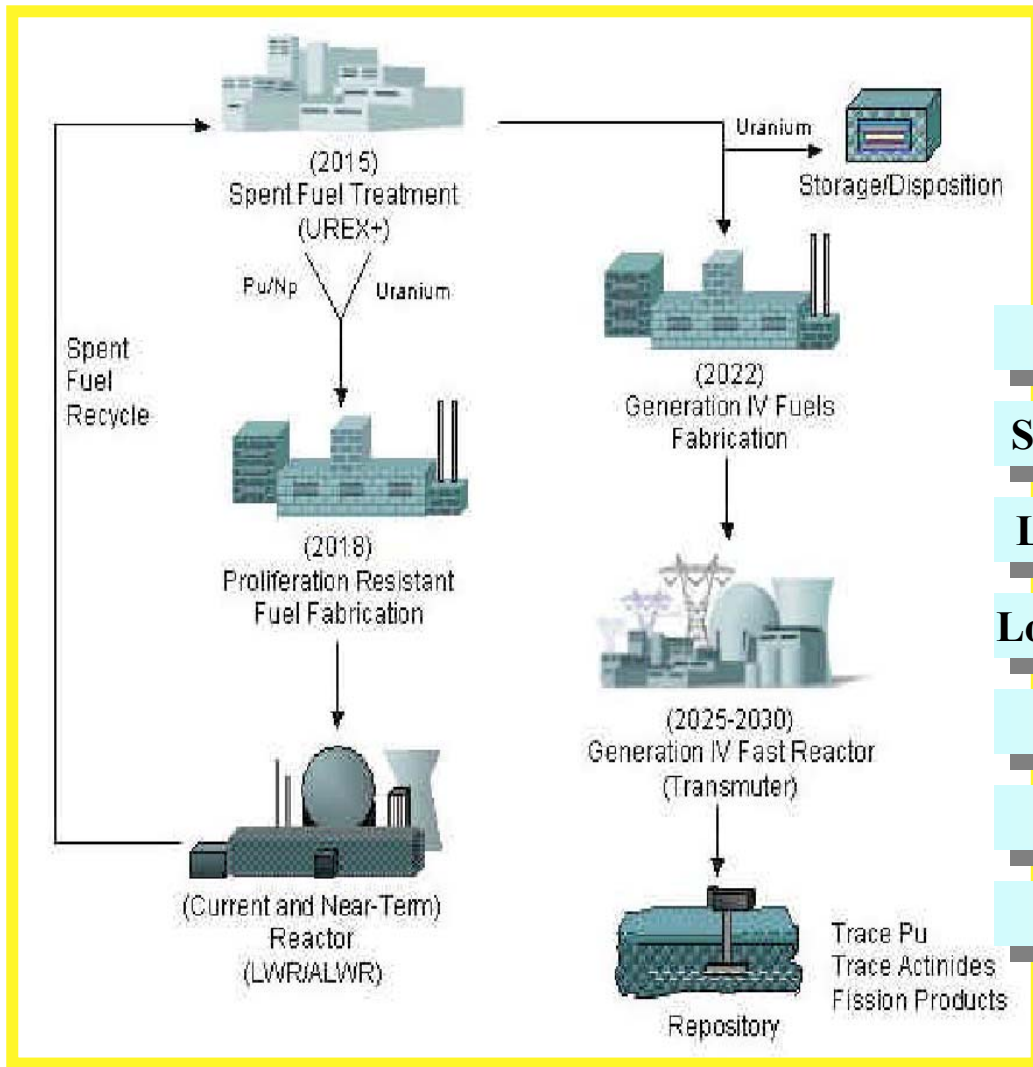
---

# *Advanced Fuel Cycle Initiative Fuels Development Overview*

*Kemal O. Pasamehmetoglu  
AFCI Fuels Development  
National Technical Director  
Los Alamos National Laboratory*

*Presented at  
AFCI Semi-Annual Review (Albuquerque, New Mexico)  
January 22-24, 2003*

# *The Fuel Development Program Addresses Both Series One and Two Fuels Needs for the AFCI*



Series One	Series Two
Volume reduction	✓
Short-term decay heat	✓
Long-term decay heat	✓
Long-term proliferation	✓
Environmental risk	✓
Radio-toxicity	✓
Criticality	✓

# *Fuel Development Program Supports the Short-Term and Long-term Goals and Objectives of the AFCI*

- Develop proliferation-resistant Pu - U oxide fuels that can be used in existing LWRs and ALWRs soon after 2015

## SERIES ONE

- By FY2007, complete
  - Fuel fabrication process definition
  - Fuel specifications
  - Performance data-packageby
  - Irradiation testing
  - Analyses
  - Comparison to MOX data-base
  - International collaborations

- Develop Pu - MA -U<sup>238</sup> bearing fuels that can be used in existing fast spectrum transmutation systems to be deployed ~ 2030

- By FY2007, determine feasible fuel options consistent with selected transmutation implementation scenario, by

- Irradiation testing
- Analyses
- International collaborations

- ## SERIES TWO
- By 2010, select final fuel form for the decided implementation scenario

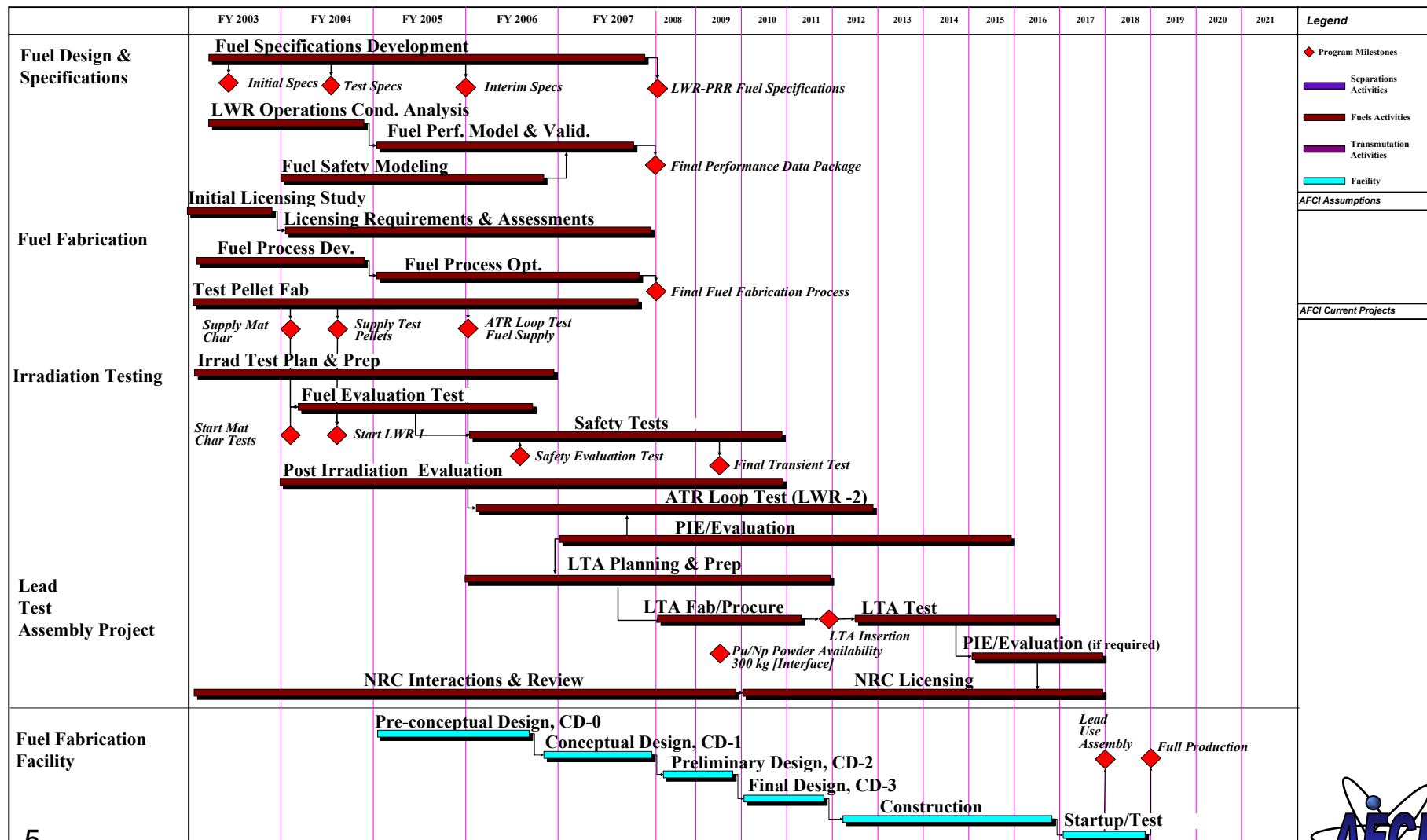
# *SERIES ONE FUEL DEVELOPMENT*

Proliferation-resistant Plutonium-Uranium  
Oxide Fuels for LWRs and ALWRs

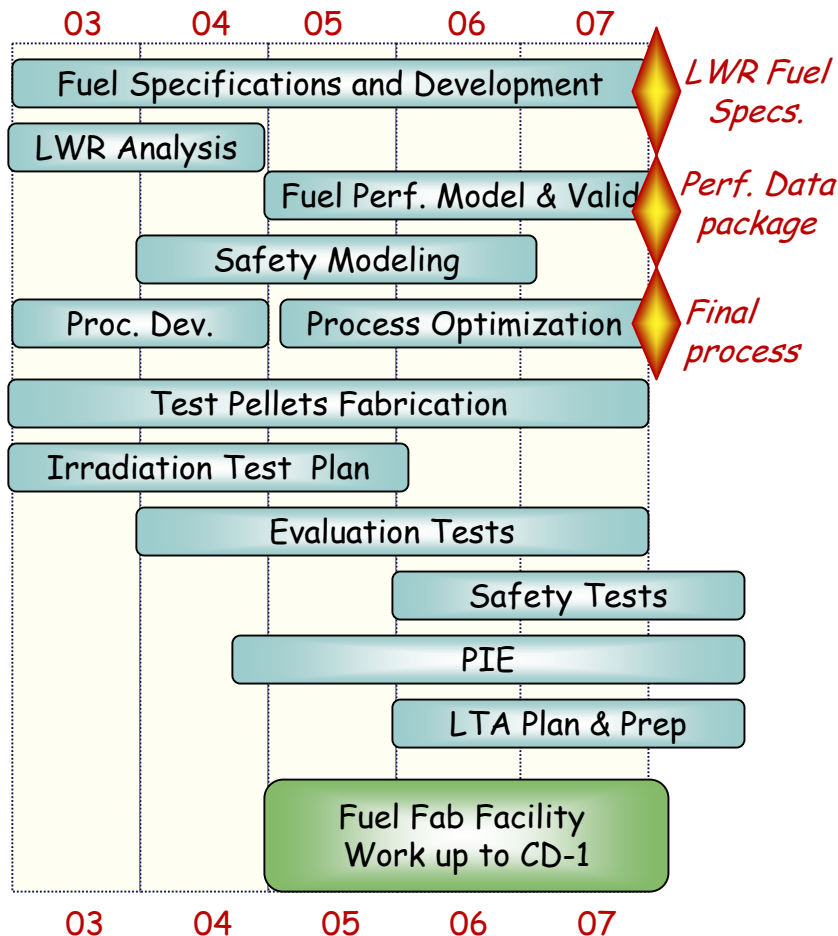
# Top-level Deployment Schedule is Driven by Series One Fuel Development

## Advanced Fuel Cycle Initiative - Fuels Series One

Rev. 0 - Pre-decisional Draft  
Updated 10/07/2002  
AFCI/DOE/NE/100



# Series One Schedule and Milestones for the First 5 Years are Driven by a Deployment Date of 2018



- Initial fuel specs and requirements
- Development plan (revised yearly)
- Fuel pellets shipped to ATR
- Start LWR-1 test in ATR
- Complete detailed test plan
- Interim fuel specs and requirements
- Complete fuel fab for LWR-2 tests
- Complete LWR-1 and start LWR-2 tests
- Complete fuel safety modeling
- Start safety evaluation tests
- CD-0 for fuel fabrication facility
- Final fuel spec and data package
- Fuel fabrication requirements
- Complete preparation for LTA
- CD-1 for fuel fabrication facility

03

04

05

06

07

# *FY03 Scope and Budget are Set to Lay the Foundations of an Aggressive Approach in the Subsequent 4 Years*

## Series One Development

Fuel Design & Specs

Work coordinated under a multi-lab working group (see next viewgraph)

Fabrication

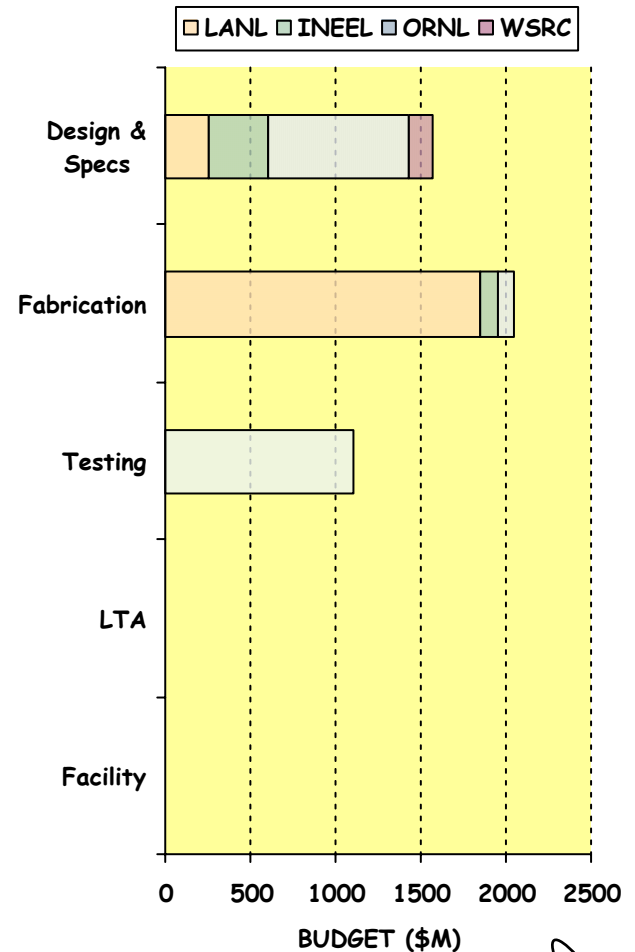
Prepare first set of (U-Pu-Np)oxide pellets for ATR irradiation

Irradiation

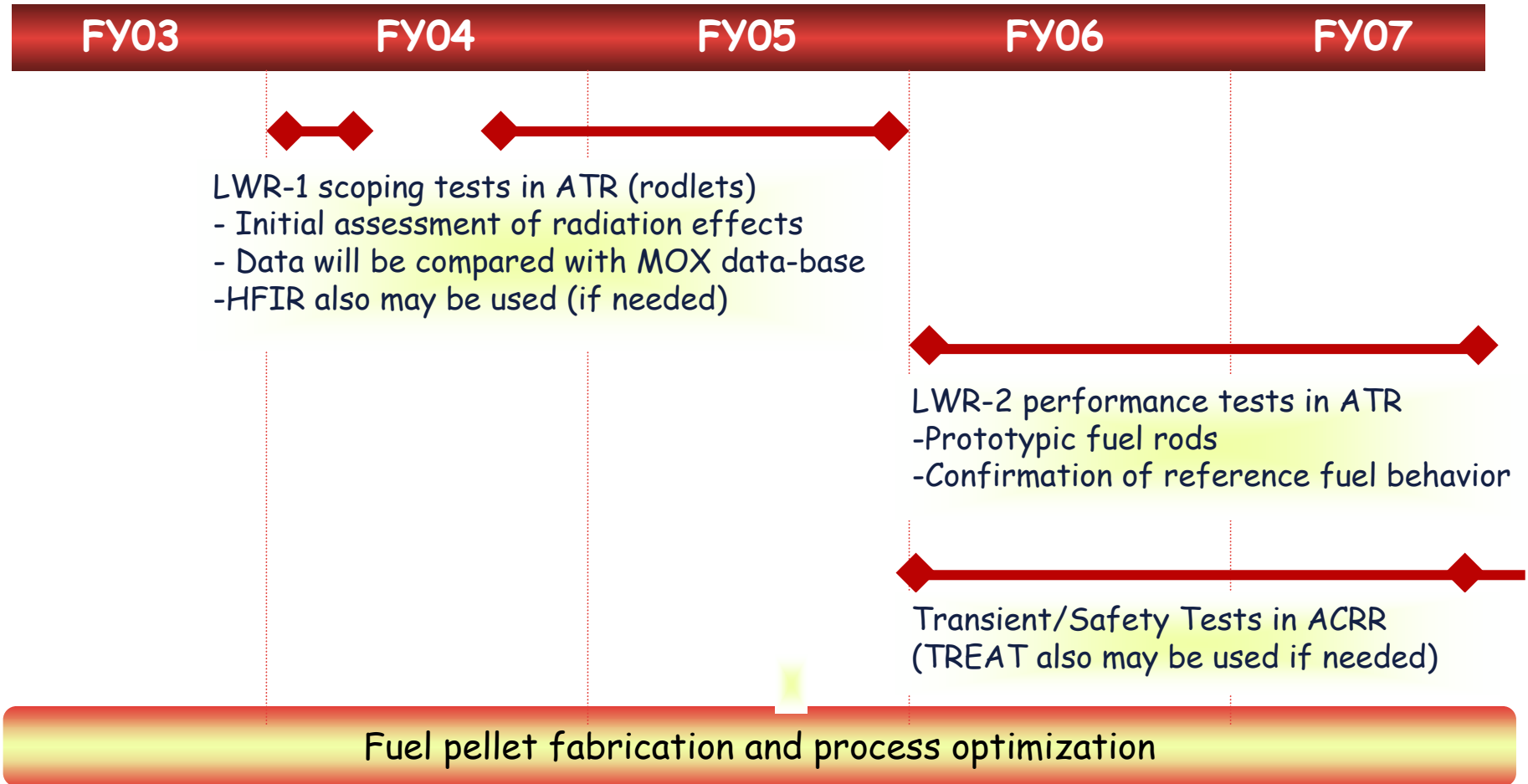
Prepare tests for the first ATR irradiation

Lead Test Assembly

Fuel Fab. Facility



# *For Series One, a Set of Irradiation Tests are Planned Leading up to LTA*





## *There are a Number of Critical Issues That Must be Addressed During Series One Implementation*

- **Schedule is very aggressive and success oriented**
  - Early definition of proliferation resistant fuel
  - Early involvement of industry and NRC
  - Early definition of licensing requirements
- **Irradiation test facilities exist**
  - Aggressive test and PIE scheduling requires timely availability of facilities
- **If NRC requires detailed transient testing, TREAT or another transient test facility may have to be restarted.**
- **A fuel composition close to standard MOX will accelerate development**
  - Early assessment of International MOX database in comparison with the Series One proliferation resistant fuel composition



# ***SERIES TWO FUEL DEVELOPMENT***

MA bearing transmutation fuels to be used in  
fast-spectrum transmuters (ADS, GEN IV)  
Advanced high-burnup fuels for GEN IV reactors

## Fertile-free fuel

- ADS
- Fast reactors with inhomogeneous core

## TRU-Rich fuel

- Fast reactors with low conversion ratio

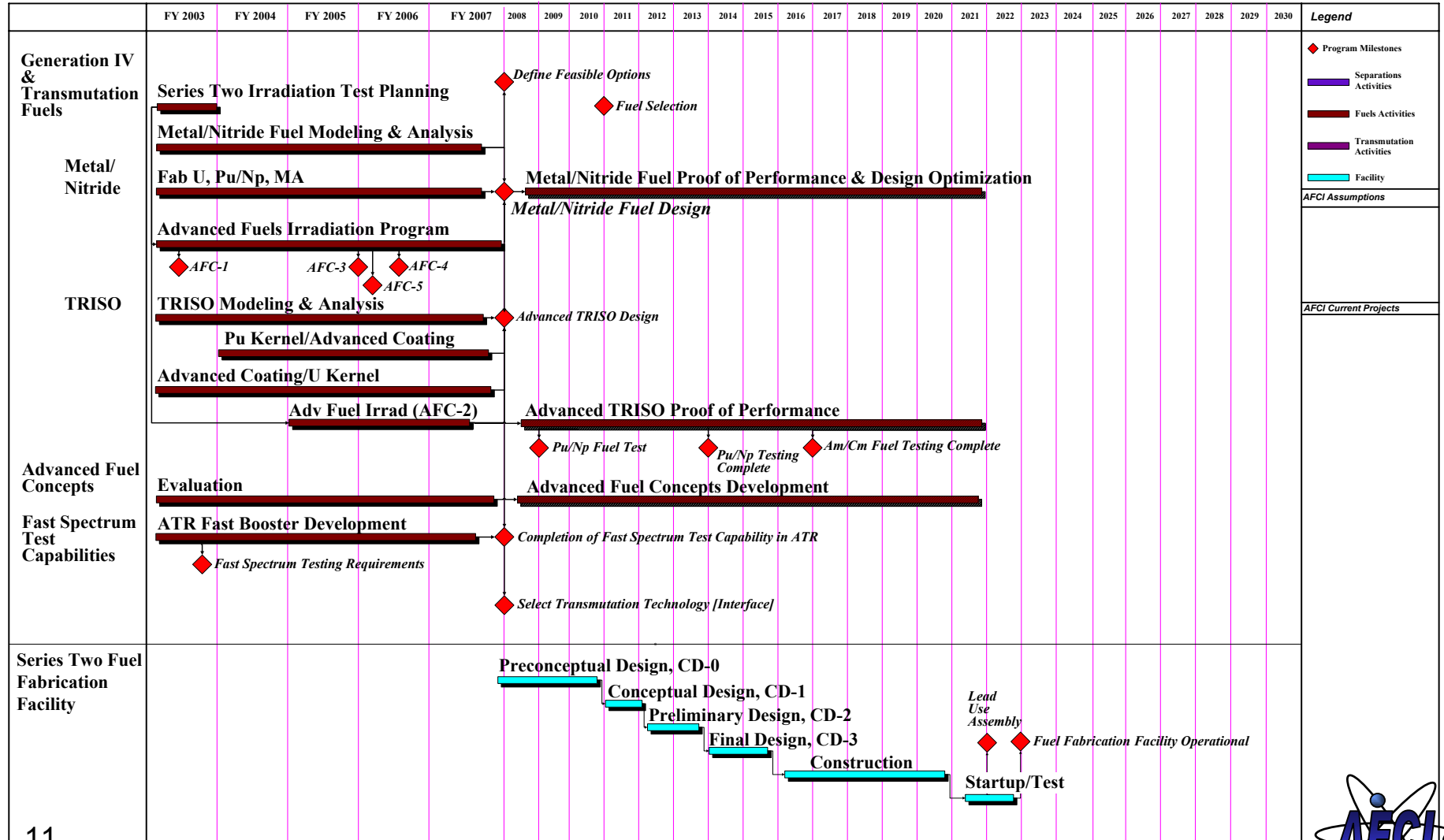
## Fertile-rich fuel

- high-burnup equilibrium fuel cycle (GEN-IV)

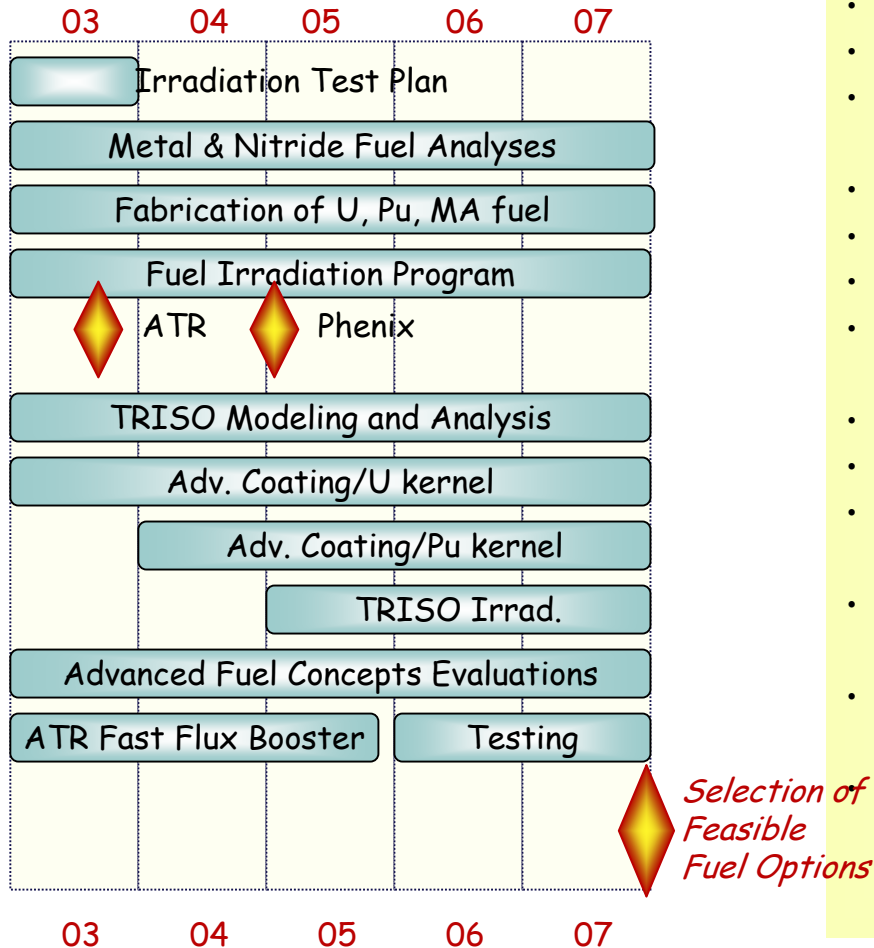
# Top-Level Deployment Schedule is Driven by Series Two Implementation Scenario and Technology Selection Decisions

## Advanced Fuel Cycle Initiative - Fuels Series Two

Rev. 0 - Pre-decisional Draft  
Updated 10/09/2002  
DOE/NE-0000000



# Series Two Efforts are Investigative in Nature During the First 5 Years Leading to Proof-of-Performance Testing After 2007



- Development plan (revised yearly)
- Fuel pellets shipped to ATR
- Down-select most promising advanced fuel forms
- Integration of AFCI and GEN IV fuel dev. plans
- Detailed fast spectrum test plans
- Complete AFC-1 test series (low and high burnup)
- Ship fuel pellets and data package to France
- Start AFC-5 (Phenix) test series
- Start TRISO (AFC-2) irradiation test series
- Complete fast flux booster in ATR
- Start AFC-6 test series
- Complete performance data packages for transmutation system selection
- Select the feasible transmutation fuel form(s)

03

04

05

06

07

# *FY03 Scope and Budget are Set to Continue with Transmutation*

## *Fuel Research for a Selection Study in Five Years*

### Series Two Development

#### Fuel Concepts & Requirements

Work coordinated under a multi-lab working group (see next viewgraph)

#### Metal and Nitride Fuels

Complete fabrication of fertile-free and fertile transmutation fuel pellets and start AFC-1 irradiation

#### Advanced TRISO fuels

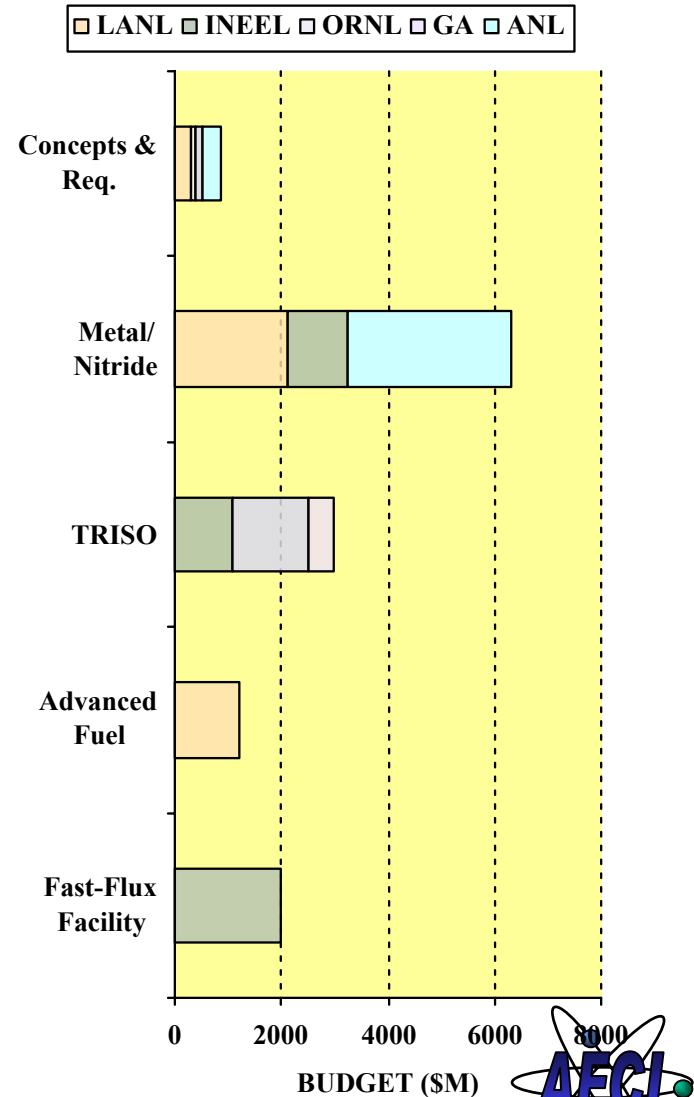
Fabrication of kernels and particles with reference coating

#### Advanced Fuel Concepts

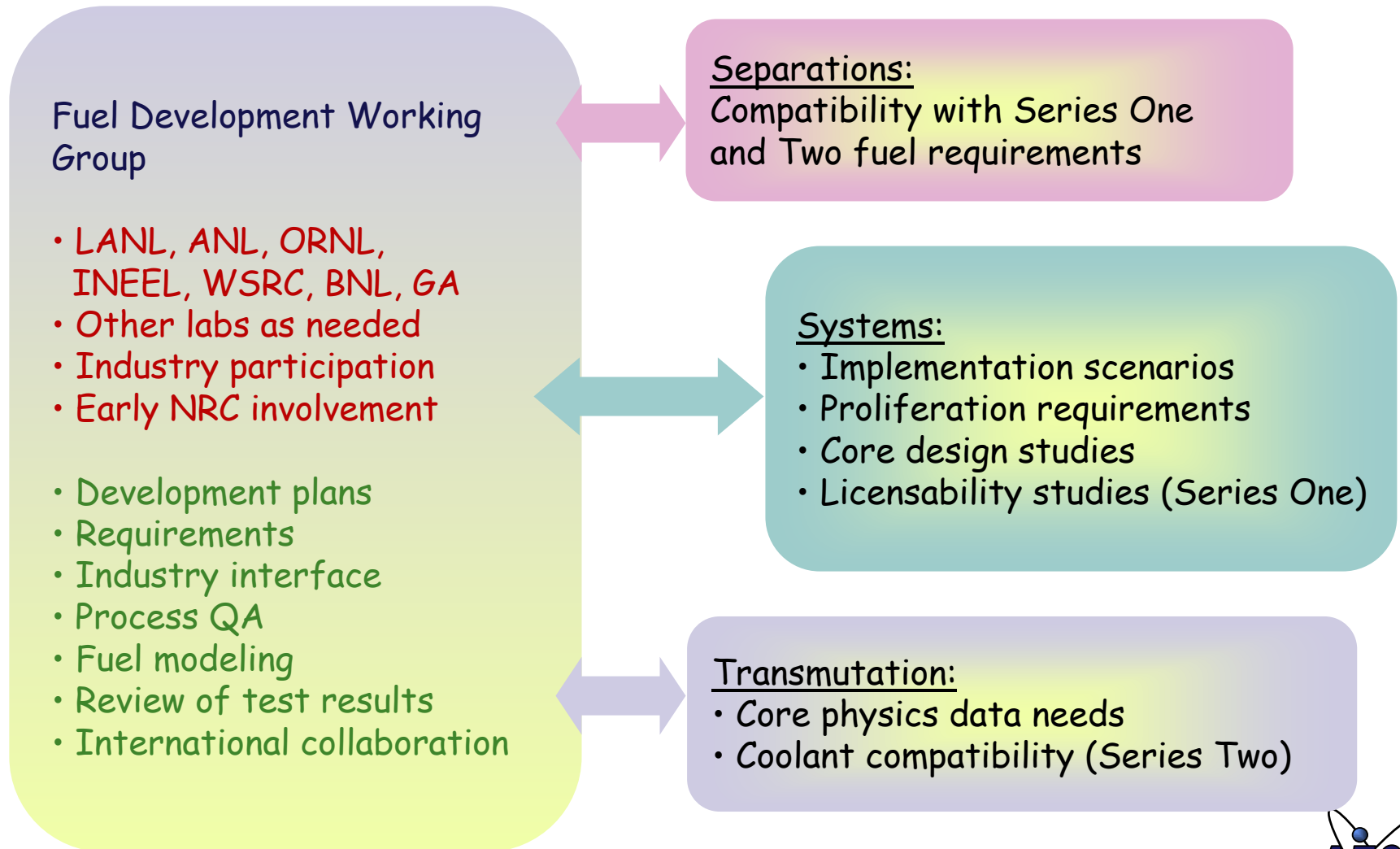
Assessment of micro- and macro-structured dispersion fuels. Selection study for further development

#### Fast Spectrum Test Facilities

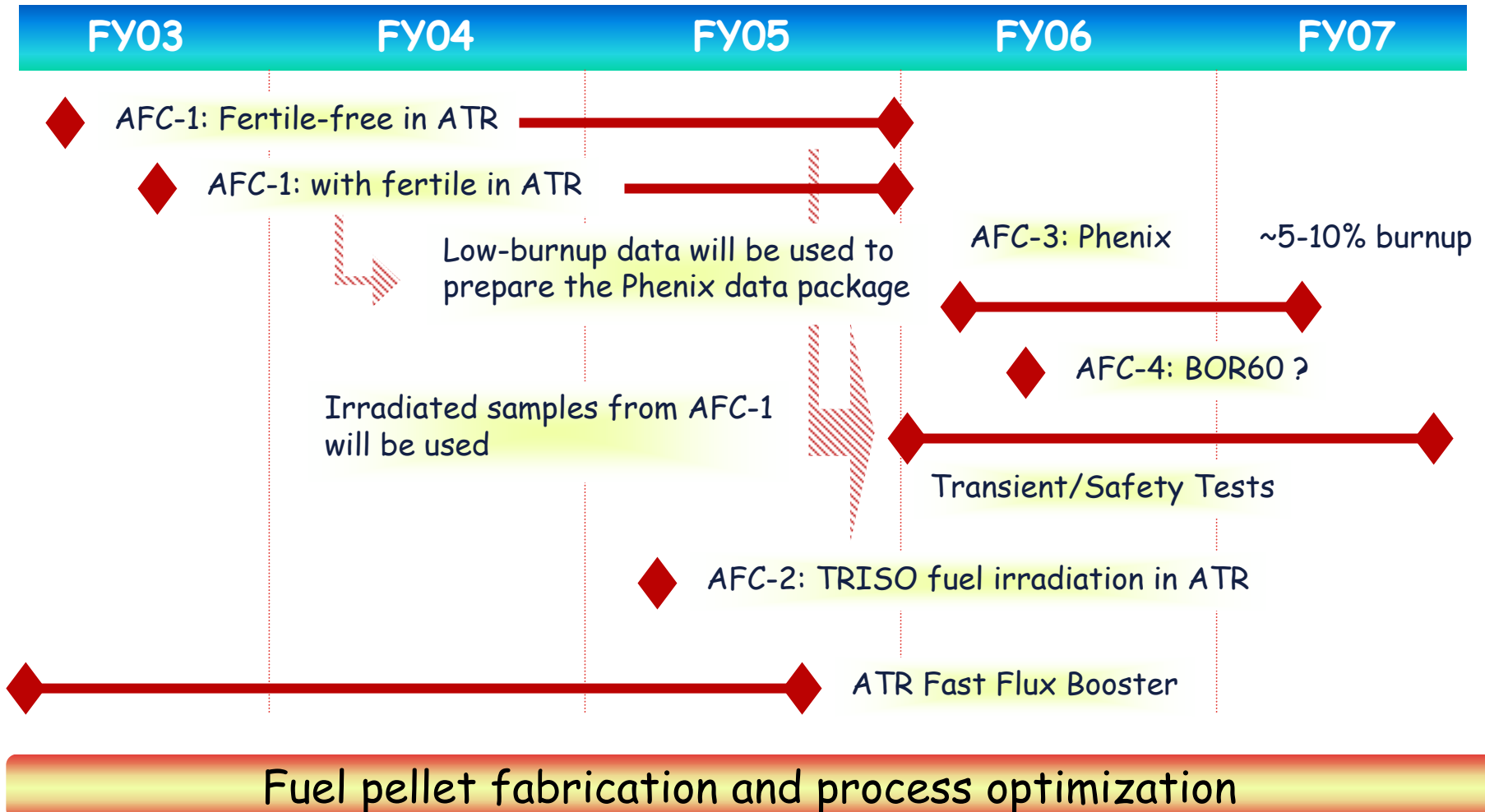
Start design of ATR fast-flux booster



# *Both the Series One and Two Fuel Research Effort will be Coordinated through a Working Group*



# *A Series of Irradiation Experiments are Planned for Selection Studies in Series Two*



## *Series Two Fuel Research will Continue in the Next Five Years and Prepare Data for Selection Studies*

- Longer development time needed because fuels containing MA have not been developed before
- Strong International collaboration is essential in developing an adequate data-base for selection studies
- Major issue is the availability of a domestic fast-flux irradiation capability to test high-burnup fuels
- Fuel compositions of interest are very strongly dependent on the implementation scenarios, especially the outcome of the front end Series One scenario
- A stronger integration with GEN IV fuel needs will be achieved early in the AFCI program (mostly in FY 2003)





## *Detailed talks are provided for the following topics:*

- Nitride Fuel Development Status (B. Margevicius, LANL)
- Metallic Fuel Development Status (D. Crawford, ANL)
- TRISO Fuel Development Status (D. Williams, ORNL)
- ATR Test Status and Schedule (R. Ambrosek, INEEL)
- Fast Flux Booster Development Status (John Ryskamp, INEEL)
- Advanced Fuel Form Development Status (K. Chidester, LANL)



# Summary of Other Tasks

## Series One Fabrication

- Depleted  $\text{UO}_2$  and  $\text{PuO}_2$  (and  $\text{NpO}_2$  and  $\text{AmO}_2$ , as needed) feedstock acquired.
- Upgrades to oxygen-to-metal-ratio measurement apparatus nearly completed.
- Furnace modifications to allow for sintering of oxides completed.
- Test runs on furnace initiated.
- First oxide sintering experiments planned for early February 03.

## MALIBU Program

- Met with Belgonucleaire to discuss program.
- Belgonucleaire cut fuel rods in Dec. '02 to obtain samples for labs.
- First technical coordination meeting to occur in Feb/Mar time frame.

## MODELING AND ANALYSIS

- Series One oxide fuel modeling and analyses efforts started and detailed progress report expected during the next quarterly.